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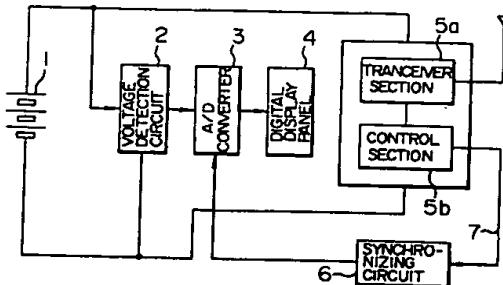
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⑤4 Device for measuring the quantity of electricity stored in a battery.

⑤7 A device for measuring the quantity of electricity stored in a battery of a transceiver comprises a voltage detection circuit (2) for detecting the battery voltage, an A/D converter (3) for converting the detected battery voltage into data, and a calculation circuit (4) for calculating the quantity of battery electricity from the voltage data. The A/D converter operates to sample the battery voltage during the period when transmission and reception are off and thus when the battery voltage does not pulsate, whereby the battery electricity can be evaluated accurately.

F I G. 1



## BACKGROUND OF THE INVENTION

This invention relates to a device which is equipped in such a radio communication apparatus as a time-division-multiplex mobile transceiver, portable telephone unit or indoor wireless telephone unit and is intended to measure the quantity of electricity stored in the battery used in the apparatus thereby to indicate the quantity of consumed electricity after the battery has been charged.

Fig. 4 shows the arrangement of a conventional device for measuring the quantity of battery electricity. In the figure, indicated by 2 is a voltage detection circuit which detects the voltage of a battery 1 and delivers the voltage level to an A/D converter 3. Output data of the A/D converter 3 is fed to a digital display panel 4, and it calculates the quantity of electricity of the battery 1 based on the characteristics of the battery, i.e., the relation between the quantity of electricity and the output voltage, and displays the result. The A/D converter 3 is capable of displaying the quantity of battery electricity consumed by a time-division-multiplex transceiver 5.

However, the conventional battery electricity measuring device shown in Fig. 4 needs to measure a pulsative battery voltage resulting from pulsative power consumption by the time-division-multiplex transceiver 5, and therefore it is deficient in the accuracy of measurement.

Particularly, a digital automobile telephone unit has its transmission power output varied in response to the radio signal from the base station, and such a varying pulsative battery voltage makes the electricity measurement more difficult.

## SUMMARY OF THE INVENTION

An object of this invention is to provide a device capable of accurately measuring the quantity of battery electricity through the synchronization of operation of the A/D converter with the time-division-multiplex control signal provided by the time-division-multiplex transceiver.

In order to achieve the above objective, the electricity measuring device based on this invention is designed to calculate the quantity of battery electricity by detecting the battery voltage during the inactive period of transmission and reception of the unit. In consequence, a stable battery voltage is detected, and the quantity of battery electricity can be measured accurately.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the arrangement of the battery electricity measuring device based on a first embodiment embodiment of this

invention;

Figs 2A-2C are waveform diagrams used to explain the operation of the device shown in Fig. 1; Fig. 3 is a block diagram showing the arrangement of the battery electricity measuring device based on a second embodiment embodiment of this invention; and

Fig. 4 is a block diagram showing the arrangement of the conventional battery electricity measuring device.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 shows the battery electricity measuring device based on this invention. In the figure, indicated by 1 is a battery, 2 is a voltage detection circuit for detecting the output voltage of the battery 1, 3 is an A/D converter, 4 is a digital display panel, 5 is a time-division-multiplex transceiver which operates on the battery 1, and 6 is a synchronizing circuit. The transceiver 5 consists of a transceiver section 5a and a control section 5b which controls the transceiver section 5a. The transceiver 5 produces a timing signal 7 for the time-division-multiplex transmission control, and the signal is fed to the synchronizing circuit 6 so that the output of the circuit 6 controls the timing of sampling of the battery voltage by the A/D converter 3.

The operation will be explained in more detail with reference to Figs. 2A-2C. The time-division-multiplex transceiver has intermittent transmission outputs as shown by Fig. 2A. This load variation causes the battery output voltage to pulsate as shown by Fig. 2B. The transmitting operation takes place in response to the command from the time-division-multiplex controller 5b in the transceiver 5, and the A/D converter 3 is designed to sample the battery voltage when transmission output is off by being timed to the timing signal 7 provided by the time-division-multiplex controller. For this implementation, the timing signal 7 is applied to the synchronizing circuit 6 so that the A/D converter 3 operates at the rising edge of the output pulse signal as shown by Fig. 2C. Consequently, according to this invention, the A/D converter 3 detects the battery voltage during the period when it is stable because of little power consumption of the battery 1, and the detection result is accurate enough to calculate the quantity of electricity of the battery 1.

Many time-division-multiplex transceivers base their time-division-multiplex control on the microcomputer incorporated in the transceiver 5, and the timing signal 7 used for this control is produced by means of programming.

The digital display panel 4, which functions to calculate the quantity of electricity of the battery 1

from the battery voltage, is mainly controlled by the microcomputer. It is also possible for this invention to use a single microcomputer and associated program for synchronizing the detection of battery voltage with the time-division-multiplex control.

Resulting data based on the accurate detection is used by the digital display panel 4 for displaying the residual electricity of the battery at a resolution of five levels for example, or indicating the alarm of too-low battery voltage.

Fig. 3 shows another embodiment of this invention. In this embodiment, the time-division-multiplex transceiver 5 shown in Fig. 1 is divided into a time-division-multiplex controller 8 and a transceiver section 9, and the synchronizing circuit 6 and digital display panel 4 in Fig. 1 are replaced with a microcomputer 10 and a display panel 11.

The arrangement of Fig. 3 operates such that the time-division-multiplex controller 8 controls the operational timing of the transceiver section 9 and imparts the timing of transmission to the microcomputer 10. The microcomputer 10 imparts the timing of operation to the A/D converter 3, which then returns the voltage data to the microcomputer 10, and it calculates the quantity of battery electricity from the data. The result of calculation of the microcomputer 10 is displayed on the display panel 11.

It is possible for the time-division-multiplex controller 8 and microcomputer 10 to be replaced with a single control microcomputer.

The present invention is also applicable to mobile transceivers of the press-and-talk design, besides the foregoing time-division-multiplex mobile transceivers.

As will be appropriated from the above explanation of the embodiments, the time-division-multiplex transceiver is provided with the function of measuring the quantity of battery electricity in synchronism with the time-division-multiplex control of the unit, and consequently the quantity of residual electricity of the built-in battery can be measured and displayed accurately.

## Claims

1. A device for measuring the quantity of electricity stored in a battery (1) which is used to power a mobile radio communication apparatus that includes a transceiver section (5a) and a control section (5b) which controls the operation of said transceiver section, said device comprising:
  - a voltage detection circuit (2) which detects the supply voltage of said battery;
  - means (4) of calculating the quantity of electricity stored in said battery from a voltage
- 5 value detected by said voltage detection circuit; and
- means (6) of activating said calculation means at a time point when transmission is not taking place as determined from a timing signal provided by said control section of said communication apparatus.
2. A battery electricity measuring device according to claim 1, wherein said mobile radio communication apparatus is based on time-division-multiplex control.
- 10 3. A battery electricity measuring device according to claim 2, wherein said electricity calculation means comprises an analog-to-digital (A/D) converter (3).
- 15 4. A battery electricity measuring device according to claim 3, wherein said electricity calculation means further includes means (11) of displaying a digital value.
- 20 5. A battery electricity measuring device according to claim 1, wherein said activation means produces a sync signal which is synchronous with said timing signal, said electricity calculation means being activated by said sync signal.
- 25 6. A battery electricity measuring device according to claim 1, wherein said control section further functions as said activation means and means of driving said display means.
- 30 7. A battery electricity measuring device according to claim 4, wherein said display means further functions as means of alarming an abnormally-low voltage of said battery.
- 35 8. A battery electricity measuring device according to claim 1, wherein said control section comprises a microcomputer (10).
- 40 9. A method of measuring and displaying the quantity of electricity stored in a battery which is used to power a mobile radio communication apparatus that includes a transceiver section (5a) and a control section (5b) which controls the operation of said transceiver section, said method detecting the supply voltage of said battery by means of a voltage detection circuit (2) at a time point when power consumption of said communication apparatus is small as determined from a timing signal provided by said control section of said communication apparatus, calculating the quantity of electricity of said battery from the detected

battery voltage, and displaying the result of calculation on a display means (11).

10. A battery electricity measuring and displaying method according to claim 9, wherein said mobile radio communication apparatus is based on time-division-multiplex control. 5
11. A battery electricity measuring device according to claim 5, where said timing signal should be fed in to voltage detection circuit (2), if voltage detection circuit has sample and hold circuit or track and hold circuit for detecting more precisely the timing. 10

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FIG. 1

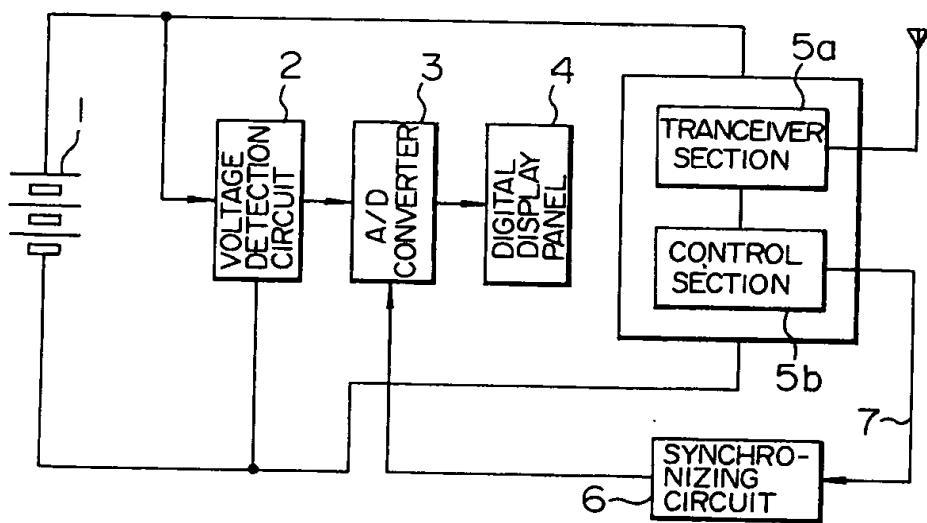


FIG. 2A



FIG. 2B



FIG. 2C



FIG. 3

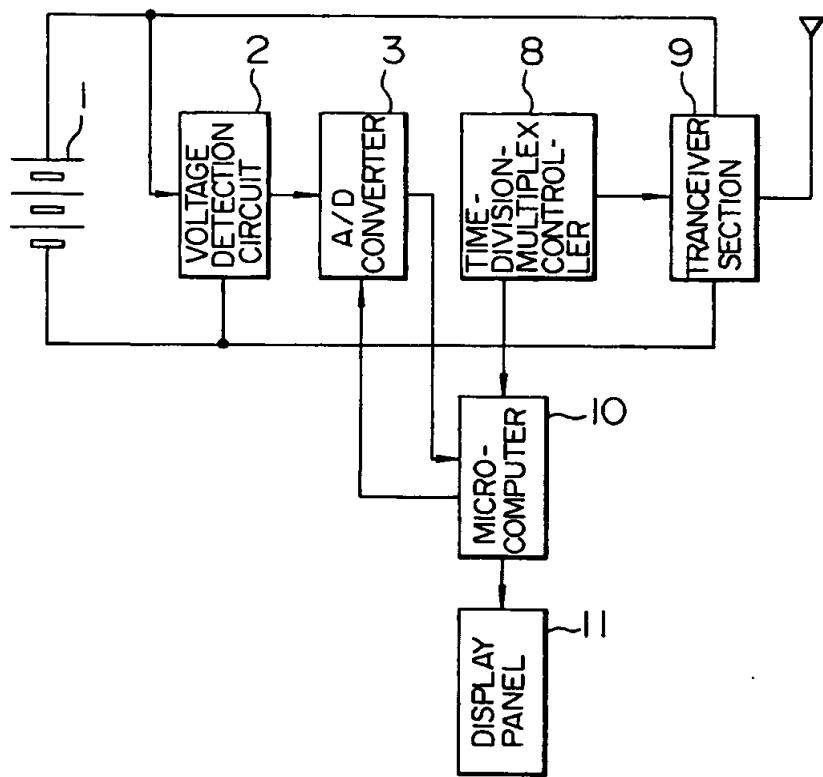


FIG. 4

